

Experiments with dynamic convolution techniques in live performance

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Outline of the talk

Context: T-EMP

Convolution explained

Dynamic convolution experiments

Sound examples

Further work

T-EMP

Trondheim ensemble for Electroacoustic Music Performance



LAC 2013

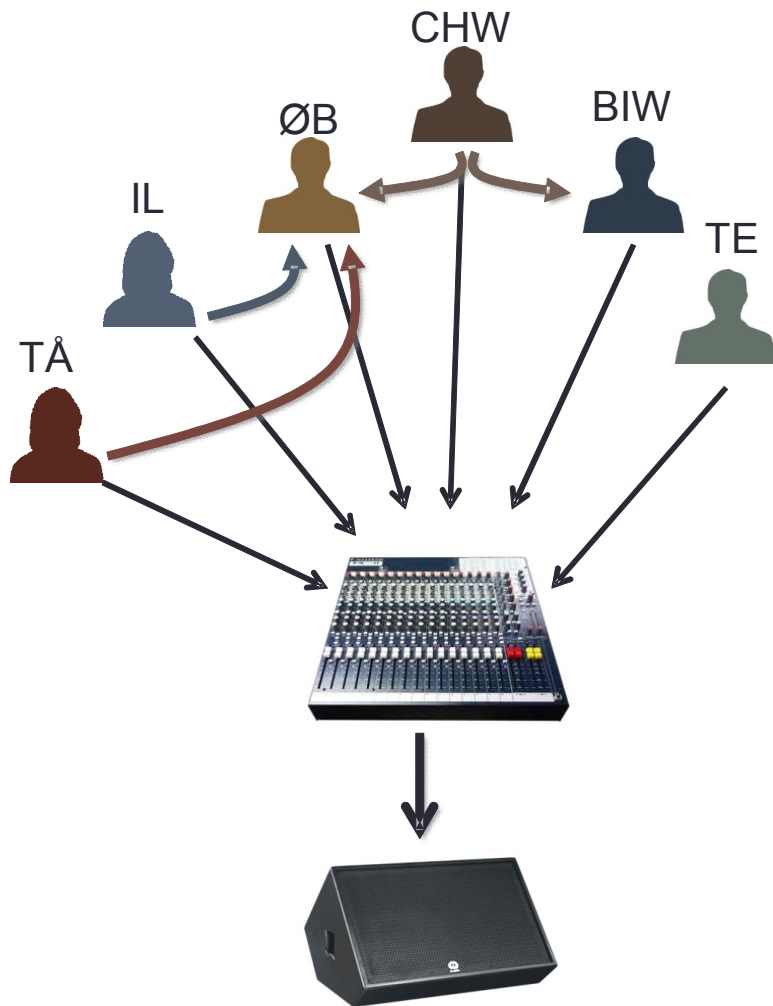
T-EMP

Trondheim ensemble for Electroacoustic Music Performance



LAC 2013

T-EMP



New modes of interplay and
communication

Improvisation

Interprocessing

Processing tools

Audio programming

- Csound
- Cabbage

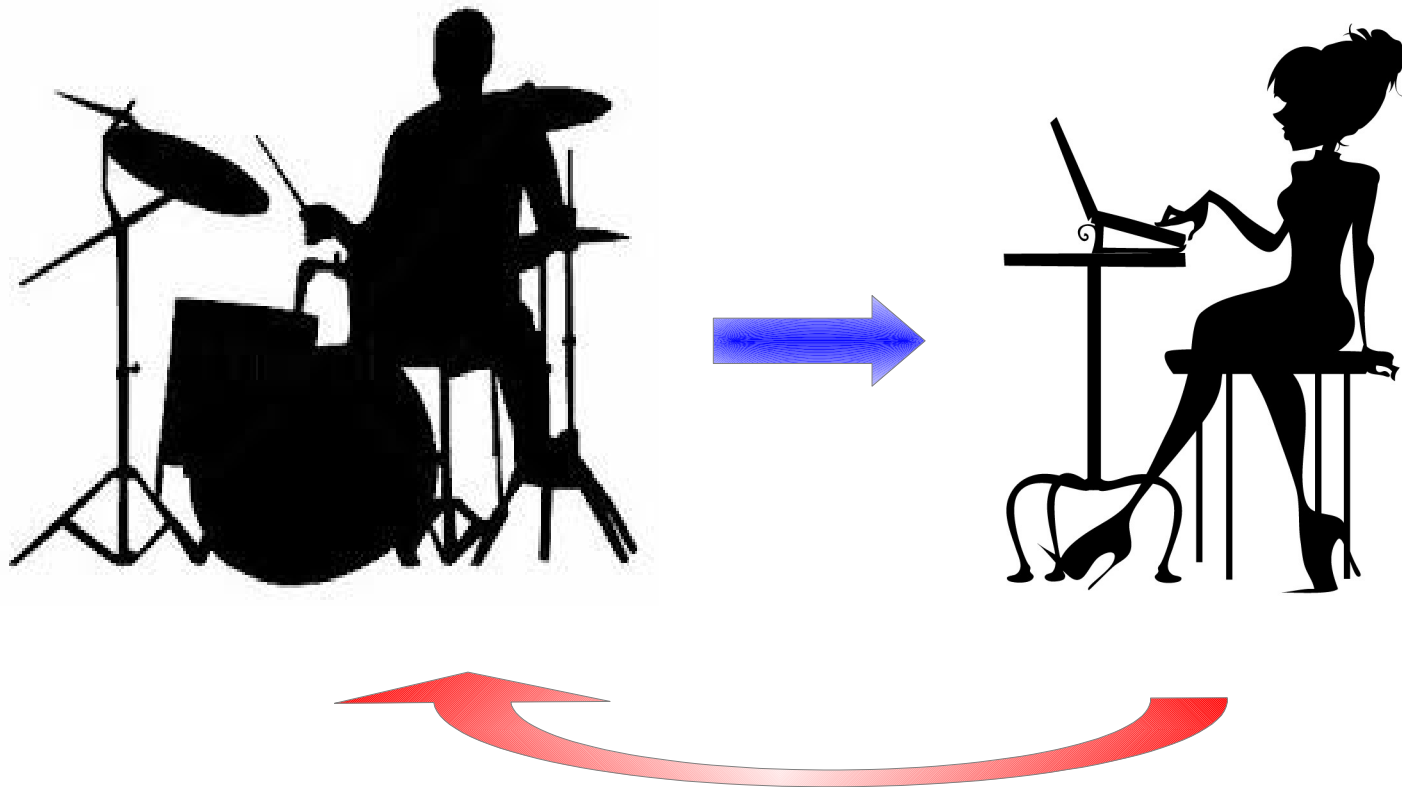


Techniques

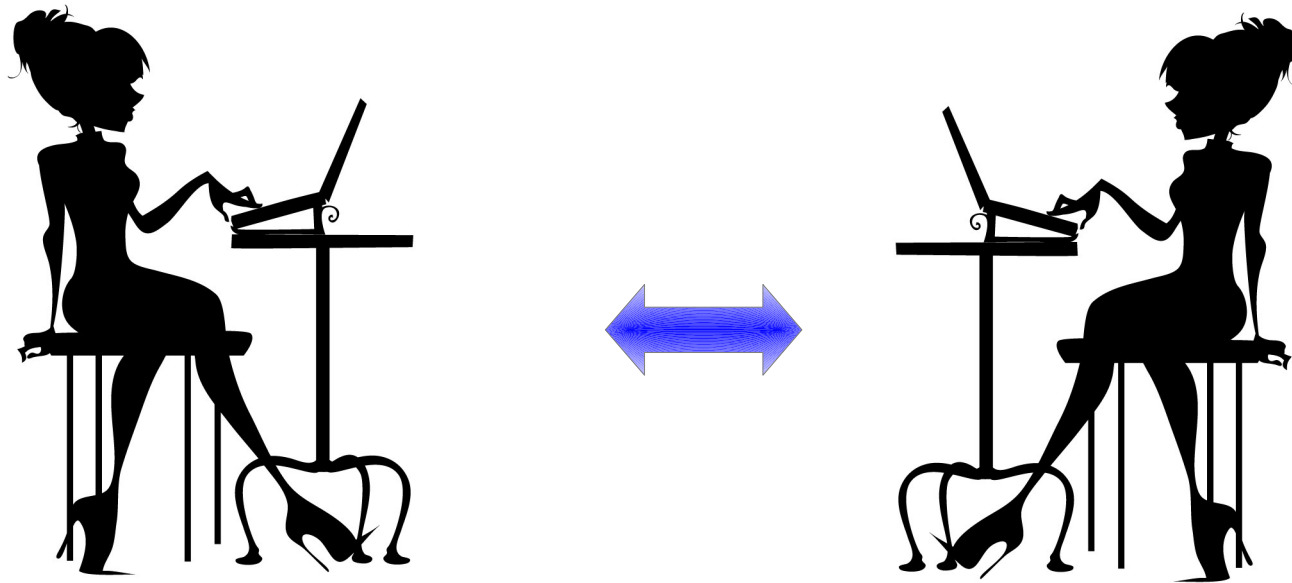
- Particle synthesis
- Convolution



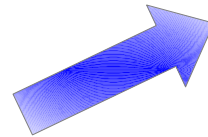
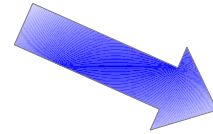
Live processing



Live interprocessing

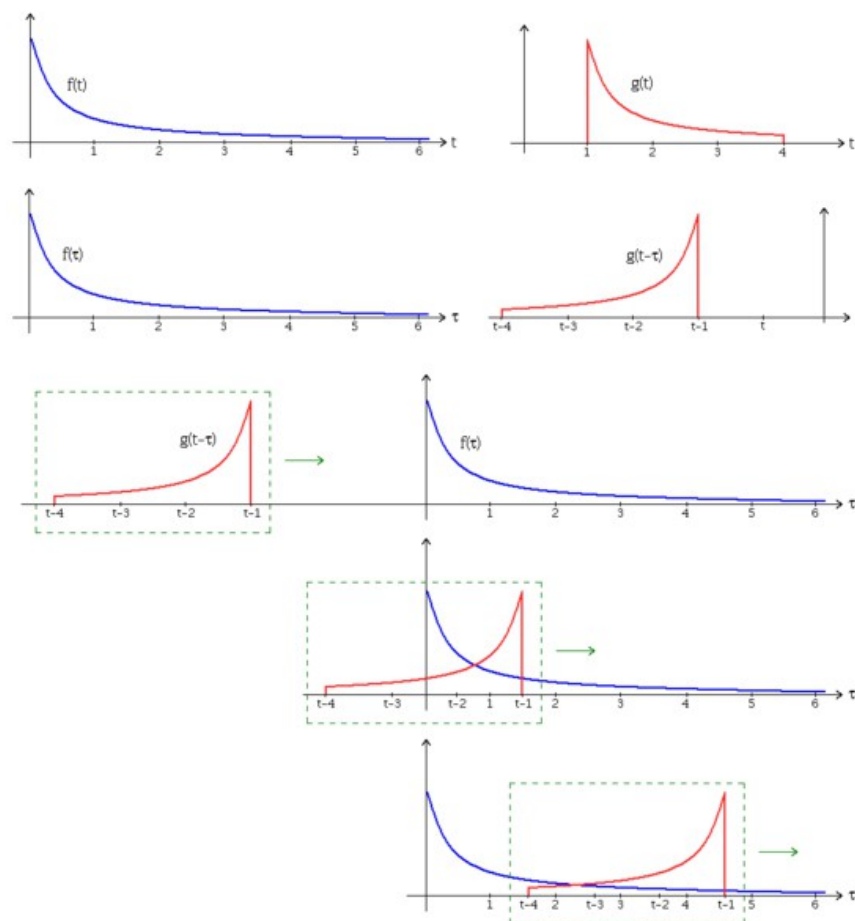


Live interprocessing



Convolution

Direct form: $f(t) \star g(t) = \sum_{k=0}^{N-1} f(k) g(t-k)$

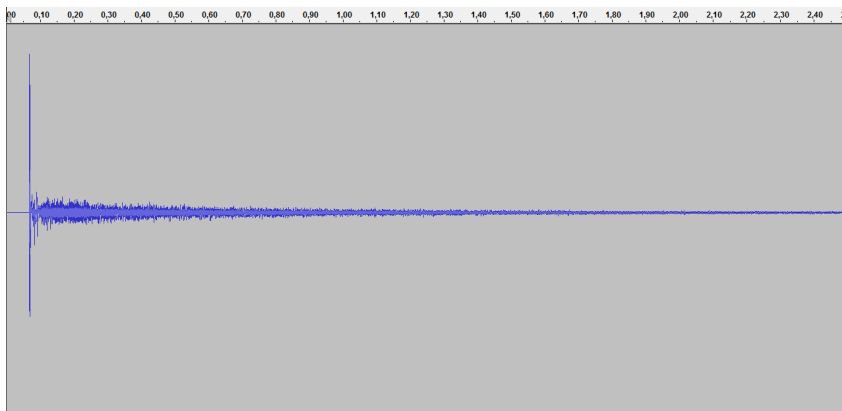


Convolution

Applications:

- FIR-filters
- Reverberation
- Spatialization
- Cross-synthesis

Impulse response (IR), $h(t)$

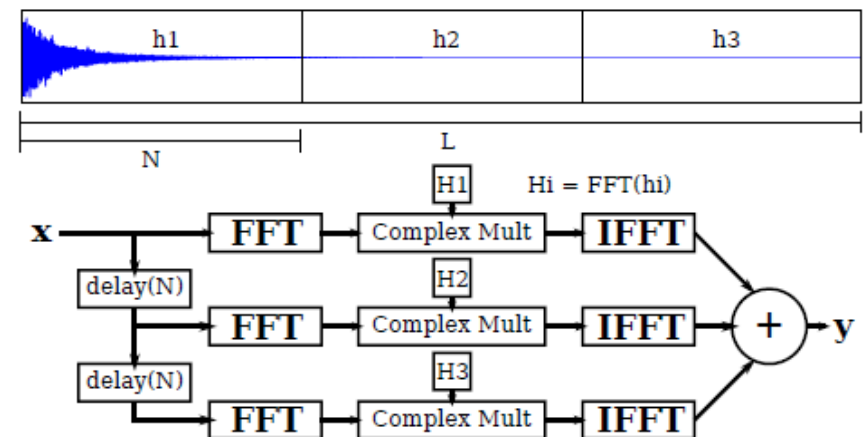


Fast convolution:

- $\mathcal{F}[f * h] = \mathcal{F}[f] \cdot \mathcal{F}[h]$
- Multiplications: $N^2 \rightarrow N \log N$

Latency:

- Partitioned convolution
- Zero-delay convolution (Gardner)



Musical goals

Dynamically updated “IR” during performance.

- Change “IR” without glitches
- Complexity (technical, practical)

Working with long “IR”

- Control of smearing

Parametric control for the purpose of playability

- Output scaling control

Convolution of 2 live sources

Approaches

Real-time convolution with dynamic impulse responses

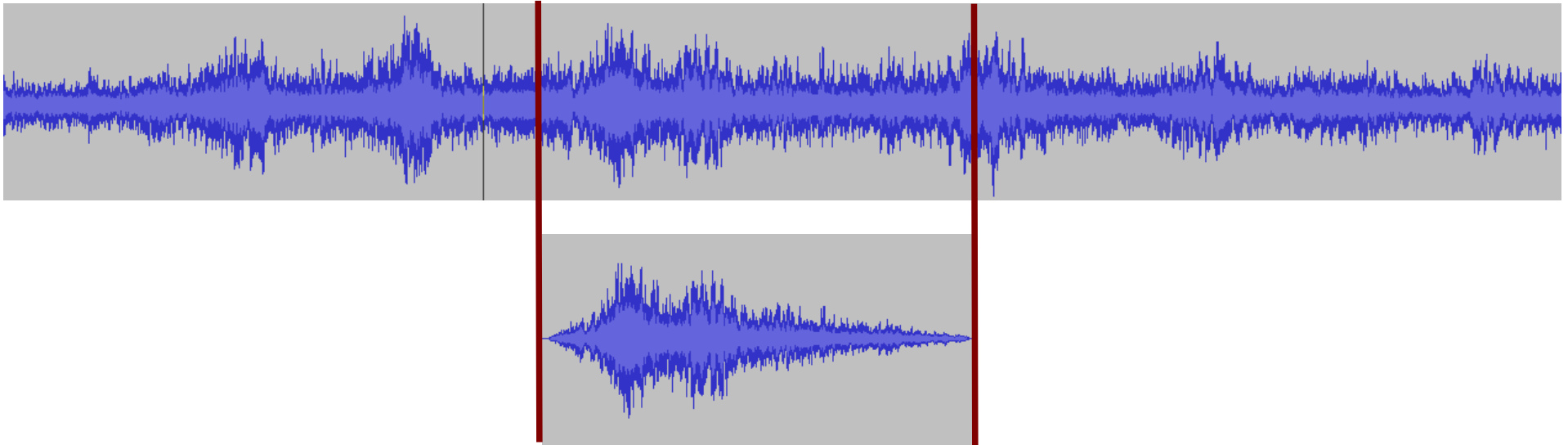
- Manual sampling convolver
- Stepwise updated impulse response buffer

Parametric control of convolution process

- Impulse response preprocessing
- Transient convolver

Live sampling convolver

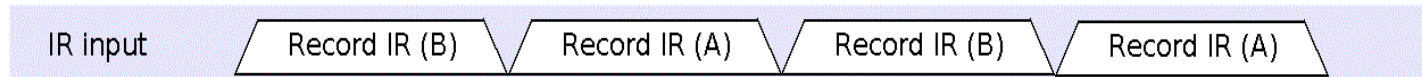
Record and replace “IR” in real-time



“IR” pre-processing

- Input level control (manual enveloping of “IR”)
- HP and LP filtering
- Other options: compression/expansion, square-root scaling

Stepwise updated IR buffer



time →

Dynamically updated “IR” in alternating buffers

Two concurrent convolution processes

- Crossfade

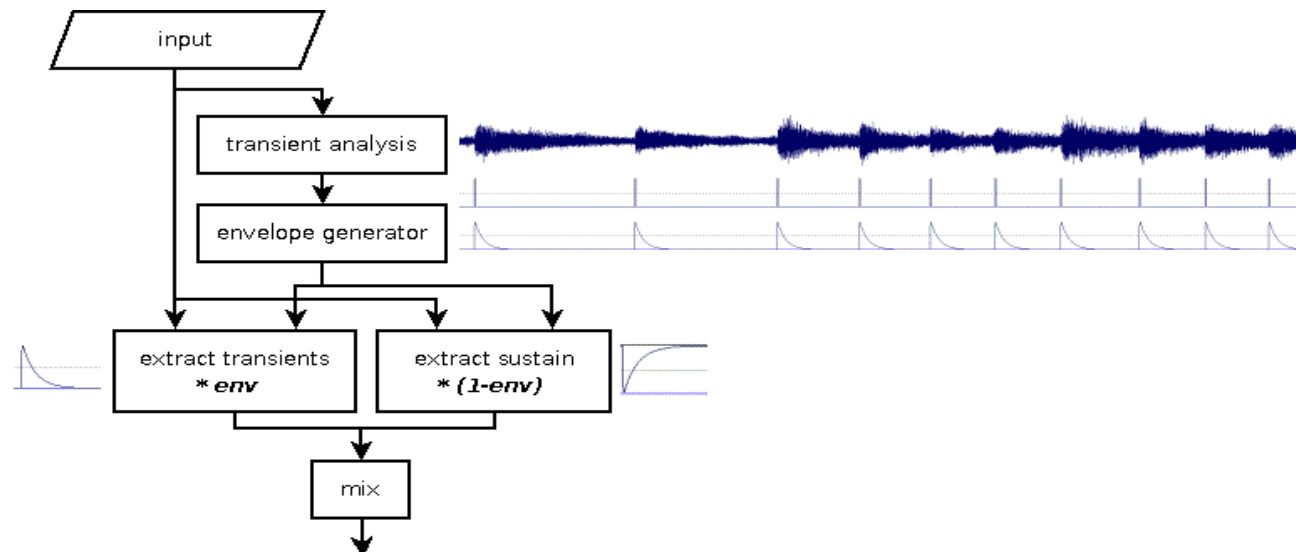
Buffer size 0.5 – 4 secs (typical 2 secs)

- Delay

Transient splitting

Challenge: Avoid excessive smearing while preserving large-scale temporal structure

- Transient-detection
- Transient-triggered envelopes
- Parametric mix of transient and sustain



The transconvolver

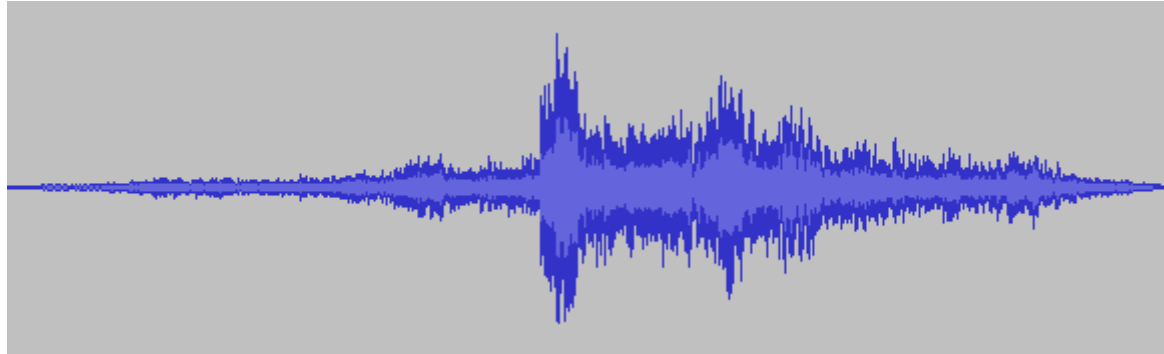
Putting it all together

- Csound → Cabbage → VST

Demo time!



Further work



Controlling irregular rhythmic behavior

- Rhythm synchronous update of impulse response
- Transient-controlled impulse response cropping
- Transient-controlled impulse response build-up

Conclusion

Exploring convolution as a inter-processing musical tool in electroacoustic ensemble performance

Variations:

- Manual sampling convolver
- Stepwise updated impulse response buffer

Parametric control:

- Impulse response preprocessing
- Transient splitting

Introducing the transient convolver

Thank you!

Questions?

Acknowledgments:

- T-EMP (in addition to Øyvind): Tone Åse, Ingrid Lode, Carl Haakon Waadeland, Bernt Isak Wærstad, Trond Engum
 - Norwegian Artistic Research Programme